An Ethical Analysis of the Engineering Profession on Progressive Structural Failure: A Case Study of the Collapse of Champlain Towers South, Surfside, Florida

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Abstract.
The tragic collapse of Champlain Towers South (CTS) in Surfside, Florida, on June 24, 2021, was a progressive structural failure that killed 98 people and became one of the most significant civil engineering disasters in recent decades. Engineering investigations indicated that the failure initiated in the transfer slab and pool deck area, which experienced severe degradation due to waterproofing failure, chloride penetration, reinforcement corrosion, and spalling, which reduced the load-bearing capacity of the elements. A 2018 report by Morabito Consultants identified "major structural damage" to the slab and columns above the underground garage, but repair recommendations were not promptly implemented by the building owner. This delay was exacerbated by inconsistent subsequent technical interpretations and ineffective risk communication. This study evaluates the CTS tragedy through an engineering ethics approach using the Indonesian Engineers Association (PII) Code of Ethics framework, including Sapta Dharma and Catur Karsa, as well as the theories of deontology, utilitarianism, and virtue ethics. The analysis results show that the engineer's obligation to prioritize public safety (duty to warn) takes higher priority than contractual obligations to the client. Failure to formally escalate to regulators when a building owner fails to respond to critical findings constitutes an ethical violation that contributed to the lack of mitigation before progressive collapse. Furthermore, indications of conflict of interest and a lack of professional rigor worsen the quality of technical decision-making. As a practical contribution, this study proposes the implementation of a "Structural Hazard Mandatory Reporting Protocol" that includes imminent hazard criteria, a tiered reporting mechanism, response deadlines, and protections for reporting engineers. This study emphasizes the importance of integrity, moral courage, and improved structural inspection standards to prevent similar failures in the future.

Keywords: *Duty to warn, Engineering ethics, Progressive structural failure, PII Code of Ethics and Corrosion of reinforcement.*

I. INTRODUCTION

Public safety, health, and welfare are the primary ethical foundations of the engineering profession. This principle, explicitly stated in the Seven Principles of Engineering, places the moral responsibility of engineers to protect the public as the highest priority in every engineering decision-making process. In civil engineering practice, this responsibility is even more pressing because the quality of planning, construction, and maintenance of structures has direct implications for the safety of human life.

The collapse of Champlain Towers South (CTS) in Surfside, Florida, on June 24, 2021, which resulted in 98 fatalities, was one of the most significant structural failures in recent decades. The tragedy not only exposed design flaws and material degradation in the 40-year-old building, but also demonstrated the significant role non-technical factors, particularly professional ethics, play in influencing a structure's final outcome.

Morabito Consultants' 2018 inspection report clearly identified major structural defects, including waterproofing failure, corroded reinforcement, and spalling that threatened the integrity of load-bearing elements. However, urgent repair recommendations were not immediately implemented due to cost considerations, differing technical interpretations from other consultants, and statements by regulators that created a false perception that the building was still safe.

The ethical aspects of the CTS case are highlighted due to the failure in risk communication and the weak response to technical findings that clearly indicated potential hazards. The dilemmas surrounding the engineer's professional duty to warn, potential conflicts of interest, and lack of moral courage in clearly communicating the urgency of the risk underscore the need for an in-depth review of the application of engineering codes of ethics in the context of this incident.

Although various international studies have analyzed CTS from a technical perspective, including the mechanisms of progressive collapse, design defects, and material degradation, the ethical dimension of engineering has not been comprehensively studied, especially in the context of the Indonesian code of ethics. There has been no research linking CTS findings with the principles of Sapta Dharma and Catur Karsa PII, and there is no operational policy model that specifically regulates mandatory reporting mechanisms when engineers encounter imminent structural hazards but do not receive an adequate response from the client or building owner.

This lack of a structured ethical and procedural framework creates a significant gap in the literature and professional practice. Therefore, this study seeks to address this gap by analyzing the CTS tragedy from the perspective of Indonesian engineering ethics. This study aims to provide a comprehensive understanding of how ethical principles can play a role in preventing structural failures and serve as a foundation for strengthening ethical standards and hazard reporting mechanisms to protect public safety in engineering practice.

II. LITERATURE REVIEW

Real Case Identification

Project background & environment

Champlain Towers South (CTS) is a 12-story condominium complex built in 1981 in the coastal neighborhood of Surfside, Florida. Its location directly adjacent to the Atlantic Ocean means the building is constantly exposed to salty, humid ocean air, a condition known to accelerate chloride corrosion in reinforced concrete. In addition to these aggressive environmental factors, CTS is also subject to Miami-Dade County regulations requiring structural and electrical recertification when a building reaches 40 years of age. As of 2021, when the incident occurred, the recertification process was underway.

On June 24, 2021, at approximately 1:22 a.m., the building's main structure experienced a progressive pancake collapse, where floors collapsed sequentially in a very short period of time. This collapse mechanism prevented most occupants from escaping, resulting in 98 fatalities. This event has become one of the most tragic structural failures in modern American construction history.

Fig. 1.*Before and After Champlain Towers South (CTS)*

(Source: Simons et al., 2022)

a. Key professional actors and critical findings

A post-disaster investigation led by the National Institute of Standards and Technology (NIST) revealed that numerous early warnings regarding the structural condition of Champlain Towers South (CTS) were ignored by various professional and institutional actors.

In 2018, Morabito Consultants, through engineer Frank Morabito, was commissioned by the Condo Owners Association to conduct an inspection as part of its 40-year recertification preparation. Their report identified “major structural damage” to the concrete slab beneath the pool deck, including waterproofing failures, severe spalling of columns and beams in the garage area, and indications of significant corrosion due to chloride-containing water penetration.

Morabito recommended major repairs worth approximately $9.1 million, later increased to $15 million, and asserted that immediate action was necessary to maintain the building's structural integrity. However, the Condo Owners Association delayed action for nearly three years due to internal debates over the cost, method, and urgency of repairs, preventing the necessary funds from being raised quickly.

The situation was exacerbated by the Town of Surfside's regulatory response. A town official in 2018 told the council that the building was in "excellent condition," an assessment inconsistent with the engineering report and giving residents a false sense of security. Furthermore, in 2020, the council hired another engineering consultant, Becker, to review Morabito's report.

This second opinion reportedly gave the impression that the building was still relatively safe for temporary use, thus weakening the perception of urgency even though repairs were still recommended. This combination of decision delays, risk miscommunication, and inconsistent technical interpretations were significant factors in exacerbating the risk before the collapse occurred.

Code of Ethics Analysis (PII)

a. Analysis of the Sapta Dharma Dilemma Point 1: "Prioritizing the safety, health and welfare of the community."

The implementation of the first point of the Sapta Dharma, namely the obligation to prioritize the safety, health, and welfare of the community, presents a complex dilemma in this case. Procedurally, Engineer Morabito (2018) has fulfilled his professional obligations by conducting a competent assessment and accurately conveying critical findings to the client, in this case the Condominium Board. Fulfillment of this contractual obligation represents a form of first-level professional accountability.

However, the essence of the ethical dilemma (duty to warn) emerges when the client entity proves inactive in following up on urgent repair recommendations over a prolonged period of time. This situation raises a philosophical question about the limits of an engineer's obligations: does his responsibility end with submitting a report to the client, or does it extend to assuming a moral obligation (primum non nocere) to take actions beyond compliance, such as escalating to the competent authorities or recommending preventive evacuation measures to protect lives.

At the macro level, the failure to actualize this dharma is systemic. Technical reports containing critical information are immobilized by bureaucratic processes and council political dynamics that do not prioritize safety. Thus, a disconnect occurs between technical hazard identification and the implementation of effective corrective actions, ultimately leading to the collapse of the very public safety protection mechanisms that should be upheld.

b. Analysis of Sapta Dharma Point 3: "Only express professional opinions based on competence and carried out with complete honesty and sincerity."

The third point of the Sapta Dharma emphasizes the obligation to only express professional opinions based on adequate competence and conducted with integrity, honesty, and sincerity. Based on the available evidence, Engineer Morabito (2018) substantively complied with this principle. His report, documented with detailed technical findings such as visual evidence of corrosion and cracks, represents a professional opinion expressed honestly, sincerely, and supported by relevant technical competence.

Conversely, violations of this principle are clearly evident in the actions of the other parties involved. If the Second Engineer, in 2020, after reviewing Morabito's technically rich report, had delivered a more lenient and comforting assessment of the building's condition, that would have constituted a serious ethical violation. Such an opinion would no longer reflect sincerity and would likely not be based on full competence, but rather dictated by non-technical interests to satisfy the client.

Furthermore, a City Official committed the same violation in 2018, who declared the building to be in "excellent condition" after learning of Morabito's report, which revealed otherwise. This statement is a clear example of dishonest and incompetent professional opinion. This action not only violates dharma but also actively misleads the public and undermines the trust that underpins responsible engineering practice.

c. Analysis of Sapta Dharma Point 4: Avoiding Conflicts of Interest

The fourth point of the Seven Dharmas emphasizes the engineer's obligation to avoid conflicts of interest that could compromise professional objectivity. A potential violation of this principle is evident in the role of the Second Engineer. If the engineer has a vested interest, such as a desire to secure a future repair contract, and therefore presents a "lenient" assessment or delays the urgent recommendations of the previous engineer, this constitutes a clear conflict of interest. Such actions place potential economic gain above the professional obligation to prioritize public safety, which is the core responsibility of the engineering profession.

d. Analysis of Catur Karsa Point 1: Prioritizing Noble Character

The first point of the Four Principles calls for prioritizing virtue, which includes integrity and moral courage in professional practice. The violation of this noble value is manifested in the collective failure to go beyond minimal contractual compliance when facing risks to human life. The entire professional ecosystem surrounding this case, from the engineer who potentially "softened" critical findings to the management board that delayed corrective action, failed to demonstrate virtue. Instead, the system prioritized financial considerations and administrative convenience over public safety, reflecting a collective decline in professional integrity standards.

EvaluationAnd Solution (Ethical Theory)

a. **Review of Deontological Theory (Duty-Based Ethics)**

A deontological analysis of this case reveals a fundamental clash between two moral obligations: the contractual obligation to maintain the confidentiality of client information against the supreme ethical obligation to protect public safety as mandated by the first point of the Sapta Dharma.

From Immanuel Kant's deontological perspective, the duty to protect human life is an absolute and universal categorical imperative, while contractual obligations are hypothetical and conditional. Although Engineer Morabito fulfilled his contractual obligations, his moral obligation transformed when the client's negligence threatened public safety. At this point, the duty to warn became a moral imperative, requiring him to escalate the situation to the appropriate authorities.

b. Review of Teleological Theory (Utilitarianism)

The utilitarian analysis revealed a systemic failure in the Condominium Board's risk calculation. The Board misjudged the utilitarian analysis by overemphasizing the short-term benefit of $15 million in repair cost savings, while ignoring the catastrophic negative utility of a building collapse resulting in 98 fatalities and total asset loss.

This act of delaying repairs represents a fundamental error in risk management, where the low probability of an event is assumed to override the magnitude of its consequences. The result is the greatest suffering for the greatest number, which contradicts the basic principle of utilitarianism.

c. A Review of Virtue Ethics Theory

Virtue ethics analysis identifies a deficit of cardinal virtues in this case. First, professional courage was not demonstrated by Engineer Morabito in escalating the danger, nor by the board in making unpopular financial decisions.

Second, honesty was compromised by the Second Engineer and city officials who glossed over critical findings. Third, a lack of responsibility was demonstrated by the board, which acted as a budget manager rather than a protector of resident safety. This collective failure to uphold these virtues reflects an erosion of moral character within the professional system.

d. Recommended Professional Solutions and Actions

Based on this ethical analysis, the ideal professional action can be formulated:

1. Professional Escalation: Engineer Morabito should have formally submitted the 2018 report to the Head of the Building Department with a covering letter affirming the ethical obligations under Sapta Dharma Point 1 after no significant action was taken in 2019.
2. Professional Independence: The Second Engineer (2020) should have maintained technical integrity by refusing to provide an opinion that undermined the previous report without independent investigation, while acknowledging the validity of Morabito's findings.
3. Proactive Regulation: City authorities should immediately issue mandatory repair orders with strict deadlines upon receiving technical reports identifying significant structural hazards.

These recommendations establish a multi-layered professional accountability framework that can prevent similar tragedies from recurring in the future.

III. RESEARCH METHODS

Research Design

This research uses a descriptive qualitative approach with a case study method. This approach was chosen because the main objective of the research is to analyze in-depth the dimensions of engineering ethics that emerged in the tragedy of the collapse of Champlain Towers South (CTS) and examine the actions of stakeholders based on the framework of the Indonesian Engineers Code of Ethics (PII). Case studies allow researchers to examine real phenomena comprehensively, especially when the boundaries between technical and non-technical aspects cannot be rigidly separated.

Data source

a. This study uses datasecondaryobtained from various credible sources, including:
b. Documenttechnical
1) Morabito Consultants inspection report (2018)
2) Findings of an investigation by the International Civil Engineering Institute
3) Post-event structural damage analysis
c. Ethical and regulatory documents
1) Code of Ethics of the Indonesian Engineers Association (PII)
2) Seven Principles of Engineering
3) Engineer's Chess of Intentions
d. International scientific sources and publications
1) Journal articles related to structural failure and progressive collapse
2) Literature on duty to warn, conflicts of interest, and risk communication in engineering

All data sources were used to construct a comprehensive understanding of the relationship between technical failures and ethical failures.

Data collection technique

Data in this study were collected using the following methods:

a. Library research to obtain the theoretical basis for engineering ethics, the PII code of ethics framework, and modern ethical theories such as deontology, utilitarianism, and virtue ethics.
b. Document analysis in the form of technical reports, investigative narratives, and recordings of statements by public officials and consultants regarding CTS.
c. A comparative study between global ethical principles and Indonesian engineering ethics to assess the relevance in the context of the CTS case.
d. This method allows researchers to identify ethical patterns that emerge from the technical and non-technical decisions of stakeholders.

Data Analysis Techniques

Data were analyzed using content analysis techniques and ethical analysis based on a normative framework. The analysis process included:

a. Categorization of technical findings Identifying the type of structural damage, failure mechanism, and maintenance actions not performed.
b. Evaluation of professional actions Assessing the behavior of engineers, building owners, and regulators based on Sapta Dharma and Catur Karsa as well as modern ethical theories.
c. Identify ethical dilemmas Determine critical points where professional obligations are not met, including duty to warn, conflicts of interest, and negligence in communicating risks.
d. Synthesis and formulation of recommendations Developing a recommendation framework for the "Structural Hazard Mandatory Reporting Protocol" as a practical contribution to the research.

IV. RESULTS AND DISCUSSION

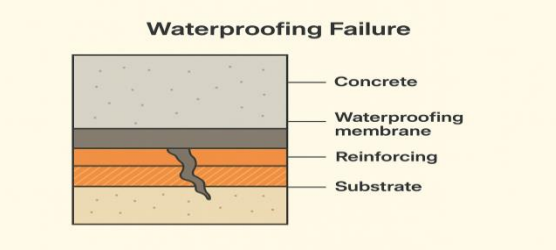
This section presents a comprehensive analysis of the progressive structural failure of Champlain Towers South (CTS) by integrating technical findings, indications of professional ethics violations, and moral evaluations based on the framework of the Indonesian Engineers Association (PII) Code of Ethics.

Case Identification Analysis and Technical Findings

The first phase of analysis work showed that the collapse of the CTS was an accumulation of original design weaknesses, highly aggressive environmental conditions, and minimal maintenance measures over more than four decades.

NIST's preliminary findings indicate that the failure likely originated from the pool deck slab, which suffered severe degradation due to chloride penetration and waterproofing failure. Severe spalling of columns and beams in the garage area accelerated the structure's capacity degradation, triggering progressive collapse.

An additional critical finding comes from the Morabito Consultants report (2018), which had actually flagged “major structural damage.” However, the technical recommendations were not immediately acted upon, and were even perceived as not urgent by other actors, including city regulators and a second consultant.



A. Fig. 2. Illustration of Waterproofing Damage

B. (Source: Personal Documentation, 2025)

4.1. Mandatory Reporting Protocol for Imminent Structural Hazards

The Protocol is designed as a tiered reporting framework consisting of five main, complementary articles. Article 1 sets out the protocol's twofold objective: (a) to provide a legal basis and ethical protection for engineers to report life-threatening structural hazards, and (b) to ensure that government authorities cannot ignore critical technical reports.

Article 2 operationally defines “Imminent Hazard” as a technical finding on a building structure such as massive waterproofing failure over primary structural elements, severe reinforcement corrosion, column spalling, or shear cracking that, in the engineer’s professional judgment, could lead to localized or progressive failure endangering life before the next scheduled inspection cycle.

Article 3 sets out the Three-Step Process which is the core of the protocol.

a. Step 1 requires the inspecting engineer to submit a written report to the client with clear, non-technical language on the cover page, for example: "Warning:**These investigation findings indicate a risk of structural failure that jeopardizes occupant safety. Immediate corrective action is required.**."

b. Step 2 gives the client a 60-day deadline to submit a formal action plan.

c. Step 3 establishes escalation obligations where the engineer must report to government authorities if the client fails to act within the specified time.

Article 4 guarantees legal protection (Whistleblower Protection) for engineers who carry out reporting obligations in good faith based on valid technical data, including immunity from civil lawsuits related to breaches of confidentiality.

Article 5 requires government authorities to respond to any report of imminent danger by issuing a "Mandatory Repair Order" or "Evacuation Order" within 14 working days, and to publicly disclose the building's hazard status. These five articles establish a comprehensive system to address the dilemma between client confidentiality and public safety.

Professional Recommendations and Policy Designers

Implementation of the protocol requires integration with the PII Code of Ethics, strengthening regulations at the national and regional levels, and launching a unified digital reporting platform. It is hoped that this policy will not only prevent the recurrence of similar incidents through clear detection and escalation mechanisms, but also strengthen the role of engineers as guardians of public safety, as mandated by the first point of the Sapta Dharma.

V. CONCLUSION AND SUGGESTIONS

Based on the results of the analysis of the Champlain Towers South (CTS) collapse case, a number of important findings can be concluded which form the basis for the technical and ethical evaluation in this study, as described below.

Conclusion

This study reveals that the Champlain Towers South (CTS) collapse tragedy was the consequence of a complex interaction between technical failures and mutually exacerbating professional ethical failures. From a technical perspective, the progressive collapse was triggered by significant material degradation in the transfer plate and pool deck areas, including waterproofing failure, reinforcement corrosion due to chloride penetration, and spalling that caused a substantial reduction in structural capacity. Morabito Consultants' 2018 technical report had explicitly stated the existence of "major structural damage," but critical recommendations were not immediately followed up, increasing the risk of structural failure.

From an engineering ethics perspective, the CTS case demonstrates a failure to adhere to the fundamental principles of the Sapta Dharma and Catur Karsa PII, particularly the obligation to prioritize public safety, maintain professional integrity, and act honestly and objectively in communicating technical conditions. Delays in decision-making, weak risk communication, and inconsistent technical interpretations reflect a failure to fulfill the duty to warn—a moral obligation that should be a top priority for an engineer. Evaluations using deontology, utilitarianism, and virtue ethics theories reinforce the finding that a number of professional actors did not adequately fulfill their moral obligations and failed to take actions that provide optimal protection for the public.

Thus, the CTS tragedy not only reflects technical failures in the building's structural system, but also exposes structural weaknesses in professional ethics governance, oversight mechanisms, and risk communication within engineering practice. This case underscores the importance of stronger integration between technical analysis and ethical frameworks, as well as the need to improve professional standards in inspection processes, structural hazard reporting, and decision-making directly related to public safety.

Suggestion

Based on the research findings, the following are relevant recommendations for improving professional practices, risk reporting mechanisms, and strengthening engineering ethics:

a. Implement mandatory reporting protocols for engineers when discovering overlooked structural hazards.

b. Standardize risk communication to be more assertive and unambiguous.

c. Strengthening the PII Code of Ethics regarding engineers' actions when critical findings are not acted upon.

d. Involving independent auditors in the building recertification process.

e. Making CTS cases as learning material for engineering ethics.

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